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WC 1

WELD SEQUENCE CONTROLLER

Operation / Installation Manual

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1.0 GENERAL DESCRIPTION

1.1 Overview

The following is a brief description of the WC 1 Thermal Arc Weld Sequence Controller. The WC 1 controller is based on an embedded micro controller. The Controller provides two 0-10 VDC programmable outputs, one is used to control the Thermal Arc Plasma Power source and the second, controls a Cold Wire Feed Motor Drive Control. The Controller provides 32 user selectable weld schedules.

1.2 Control Outputs

The controller has five solid-state isolated relay outputs. One output is configured as an arc start signal to the Thermal Arc power source. The remaining four has the following default configuration:

- **CR1 - Ready** – This output is asserted when the Controller is operating normally. It will reset when the controller is in ESTOP or an Internal/External fault has occurred.

- **CR2 - Arc Active** – This output is asserted after the arc is established. The signal is generated from the Thermal Arc power source. The output is cleared if a loss of arc is detected, internal Program fault, or the cycle start signal is reset.

- **CR3 - Cycle Complete** – This output is asserted when the programmed weld cycle has been completed. If a fault or loss of arc has occurred during the cycle the Cycle complete will not be set.

- **CR4 - Cycle Active** – This output is active during the complete weld cycle and will be cleared at the end of all programmed events.

1.3 Control Inputs

The Controller provides nine 24 VDC Optically isolated inputs. Three inputs are dedicated for ESTOP, Arc Active and Pilot Arc Active. The Arc Active and Pilot Arc Active inputs are connected to the Thermal Arc power source. The ESTOP input may be internally set to the active state. The remaining six inputs may be configured for remote schedule or program control. The nine inputs have the following default configuration:

- **ESTOP** – This input must be active. If the ESTOP is cleared the control performs an emergency stop and halts the weld cycle and resets all outputs. When asserted the controller performs a power up sequence.

- **ARC ACTIVE** – When asserted the controller will initiate the Start Timer Event. If the weld is not initiated within 2 seconds of cycle start the control will terminate the weld cycle and clear the Ready Output. The user must clear the Cycle start input to reset the Ready output.

- **PILOT ARC ACTIVE** – This input must be asserted to set the Ready output and to allow the controller to perform a weld cycle. An external jumper can force this input.

- **INP 1 – SCHED 0** – User definable spare input. Under remote schedule mode this input can be used for weld schedule selection (Bit 0).

- **INP 2 – SCHED 1** - User definable spare input. Under remote schedule mode this input can be used for weld schedule selection (Bit 1).

- **INP 3 – SCHED 2/ PARAMETER SELECT** - User definable spare input. Under Remote Schedule Mode this input can be used for weld schedule selection (Bit 2). Under Remote Control Mode this input is used to select the parameter to Increase/Decrease. When Cleared the Current is selected. When Asserted the Wire Feed speed parameter is selected. This option is only active when the optional wire drive and when the Remote control mode is enabled.

- **INP 4 – SCHED 3/ INCREASE PARAMETER** – User definable spare input. Under Remote Schedule Mode this input can be used for weld schedule selection (Bit 3). Under Remote Control Mode activating this input will increment the selected parameter as specified by INP3. The maximum increase level can be user defined for each weld schedule.

- **INP 5 – SCHED 4/ DECREASE PARAMETER** - User definable spare input. Under Remote Schedule Mode this input can be used for weld schedule selection (Bit 4). Under Remote Control Mode asserting this input will decrease the selected parameter as specified by INP3. The minimum decrease level can be user defined for each schedule.

- **INP 6 - CYCLE START** – This Input, when asserted, will start a weld cycle and must be active during the complete weld cycle. If the input is reset the cycle will be terminated. If the Spot Weld mode is enabled, the weld cycle will be terminated by the user defined weld time. The Cycle start input must be reset before the next weld cycle can be initiated.

1.4 Control Display and Status Indicators

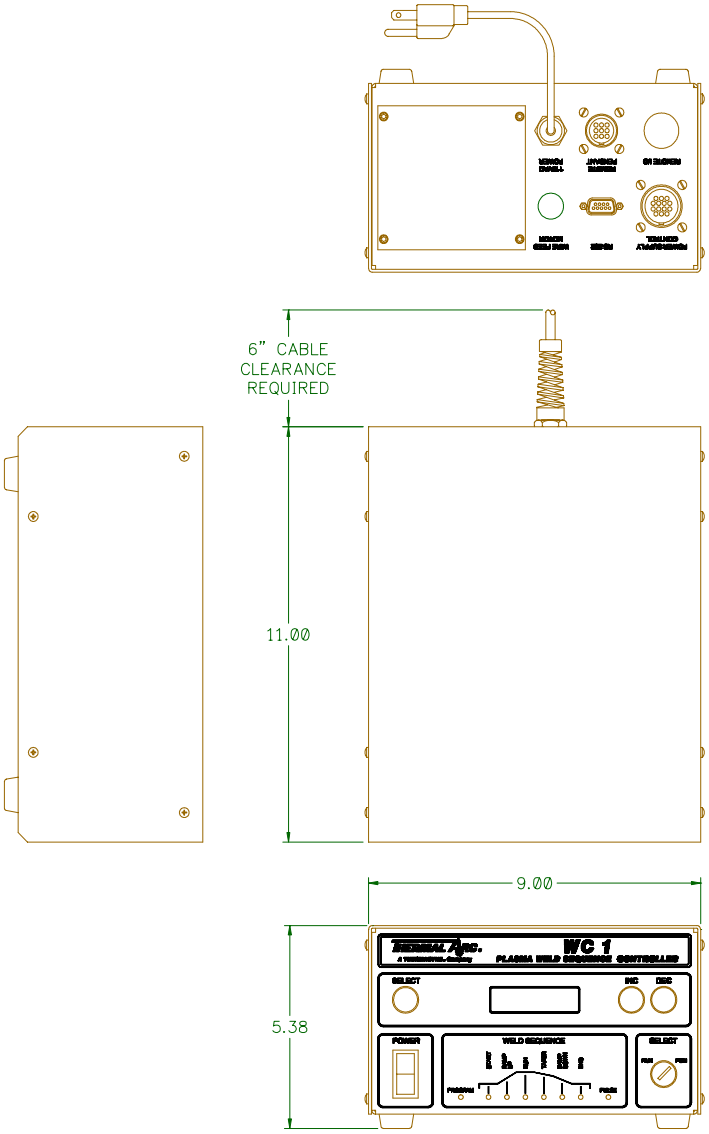
The controller has a 2-line 16-character Alpha Numeric LCD display which is used to program the weld schedule data and to configure the control options. Three push button switches are used to select the desired parameters and to increment or decrement the values. A Program/Run key lock switch is provided to prevent unauthorized access to the WC 1 weld schedule and system configuration. Eight Status LEDs are used to indicate the weld sequence events and selected modes. The Program LED is illuminated when the WC 1 is in weld sequence mode. The Pulse LED is illuminated when the Pulse Weld function is active. During a weld cycle the status LEDs will be illuminated to indicate weld event sequence being executed. A RS-232-C serial port is provided and allows the user to program all of the WC 1 schedules and features off-line.

2.0 CONTROL INSTALLATION

2.1 Enclosure Installation

Install the Enclosure in a convenient location that allows easy operator access to the front control panel. Allow a minimum clearance of 6" (152mm) from the rear of the enclosure to allow access for the external cable connections. To permanently mount the enclosure remove the four rubber feet and mount the enclosure using blind-hole fasteners located on the bottom of the enclosure. Connect the Power cable to a suitable source of AC power. Connect the Power supply remote cable to the "POWER SUPPLY CONTROL" receptacle. Connect the optional operator pendant control cable to the "REMOTE PENDANT" receptacle.

2.2 Standard Enclosure Dimensions



2.3 Remote Control Receptacle

The optional remote control receptacle provides a basic operational control interface to the WC 1 controller. The following is the pin-out and control function for the 9 pin receptacle.

PIN	DESCRIPTION
1	+24 vdc @ 100 ma. Power Output
2	ESTOP – 24 VDC input
3	CYCLE START – 24 VDC input
4	INC – 24 VDC Input. Increase the current during the weld cycle
5	DEC – 24 VDC Input. Decreases the current during the weld cycle
6	CYCLE ON - 24 VDC Active low sinking (Pull-Down) output
7	CYCLE COMPLETE – 24 VDC Active Low sinking (Pull-Down) output
8	EARTH GROUND
9	READY – 24 vdc Active Low sinking (Pull-Down) output

Table 1 - WC 1 Remote Control Receptacle Pin-Out

3.0 WELD SEQUENCE EVENTS

3.1 Weld Sequence Parameters

The WC 1 Plasma Weld Sequence Controller provides the following user defined parameters:

- **START CURRENT** – The value of current to be used during the start time event.
- **START TIME** – The amount of time to hold the start current before beginning the Ramp Up Event.
- **RAMP UP TIME** – The time required to ramp from the start current to the run current.
- **RUN CURRENT** – The value of current to be used during the Run time of the weld cycle.
- **WELD TIME** – The user defined spot weld time when enabled.
- **% TAPER CURRENT** - The % of Run current used as the end current level for the taper time and the start of the Ramp Down Event.
- **TAPER TIME** – The amount of time required for the Current Taper Event.
- **RAMP DOWN TIME** – The amount of time required to ramp from the % Taper current value to the End current value prior to the End Current Event.
- **END CURRENT** - The end cycle current level to be used during the End Cycle Time.
- **END TIME** – The amount of time required for the end weld event.

3.2 Pulse Weld Mode Parameters

If the Pulse mode is enabled the following parameters will be used to define the pulse conditions:

- **PULSE ON TIME** – Specifies the Pulse On time period when the Pulse mode is enabled.
- **PULSE OFF TIME** – Specifies the Pulse Off time period when the Pulse mode is enabled.
- **% PULSE CURRENT** – Specifies the percent of the Run current that will be used during the Pulse Off time period.

3.3 Weld Cycle Events

The Weld cycle is initiated by asserting the Cycle Start Input. The controller will monitor the Arc Active input and will assert the Active output when active. The controller will set the Thermal Arc Power source to the value specified by the Start Current Parameter. After the Start time has expired the Current output would be ramped to the Run current value over the Ramp Up time specified. At the end of the Ramp Time the Run current value will be active. If the Pulse mode is enabled the Pulse On time will be used to specify the time at Peak Current. The Pulse Off Time and Percent Current will be used to define the background pulse condition. If the Spot Time is Disabled the controller will continue to operate in the Run Event. When the Cycle Start is reset the controller will begin the Taper Time and ramp the Run current to the level specified by the Percent Taper parameter. If the Pulse mode is enabled the pulsing will start during the Ramp Up event and will continue through the ramp down event. At the end of the ramp down time the controller will set the End Current value and will hold this value for the time specified by the End Time parameter. The

Cycle Complete will be asserted at the end of the weld cycle when the Arc Active Signal has been cleared by the power source. The Cycle complete will remain set until the next Cycle start is asserted. To disable any weld event set the associated time to zero.

3.4 Spot Weld Mode

If the Spot Time mode is enabled the Taper Event will be started at the end of the Spot Weld Time. Then the normal end events will be executed. In this mode the Cycle Start must be active until the end of the weld cycle. The Controller will not reset the weld event until the Cycle input has been cleared. The Cycle complete will be asserted when the Arc Active Signal is cleared. The Cycle Complete Output will be cleared when the Cycle start is cleared.

3.5 Arc Active Test

If the Arc Active input from the power source is not active within the user specified start time after the cycle start has been asserted, the controller will clear the weld event and reset the Ready Output. The Cycle Start input must be cycled off before the Ready Output can be asserted. If the Cycle start input is cleared prior to the weld event the controller will terminate the arc and will not set the Cycle Complete output.

4.0 USER INTERFACE

4.1 Remote Control Interface Specification

The WC 1 Controller provides a remote control interface that allows the user to connect an external PLC or robotic control to the WC 1. The interface provides remote schedule select, cycle start and operational status indication. The WC 1 inputs are configured to operate from a 24 VDC power source. The inputs can be configured for Pull-Up (Sourcing) or Pull Down (Sinking). A 24 VDC @ 200MA isolated power supply (TB5) is provided to allow dry contact closures to activate the WC 1 inputs. All Relay Outputs are opto-isolated solid-state relays and will switch AC/DC loads up to 120 VAC at 1 amp.

4.2 Remote Pendant Interface

A 9 pin CPC circular connector is provided to allow the use of a manual operator control pendant. The Optional Operator Pendant is designed to connect to this Operator Control connector and will perform the following Control functions:

- **ESTOP** – Palm button provides emergency stop input to the weld control.
- **CYCLE ON** – Toggle switch to start and stop a weld cycle.
- **INC CURRENT** – Pushbutton switch used to increase the Run current during a weld cycle. The control will provide user defined limits for current change.
- **DEC CURRENT** – Pushbutton switch used to Decrease the Run current during a weld cycle. The control will provide user defined limits for current change.
- **READY** – Green LED Indicator.
- **CYCLE ON** – Red LED Indicator.
- **CYCLE COMPLETE** – Green LED Indicator.

4.3 Optional Operator Pendant

The Operator Control Pendant is a NEMA 1 rated clamshell enclosure with a 15 ft control cable and Remote I/O plug. If the WC 1 controller is to be used in a robotic or PLC based application the remote pendant option is disabled and the inputs must be reconfigured for the desired remote PLC/Robotic control functions.

4.4 RS-232 Serial Port

All weld schedule programming can be performed off-line via a RS-232 serial port or using the internal display and program buttons. The Internal display allows the user to program all of the WC 1 Plasma Weld sequence parameters and to configure the controller operational modes. It can also be used to Save and Load internal weld schedules.

4.5 Automated User Interface

The WC 1 controller allows full remote control capabilities for use with PLC or robotic controllers. The control provides a 24-vdc interface that allows the users to select weld schedules and to start/Stop the welding sequence. The controller provides a simple hand shaking output that allows

the Host controller to validate the weld sequence. Four relay outputs provide the following information to the host controller:

- **CR1 - Ready** – This output is asserted when the Controller is operating normally. It will reset when the controller is in ESTOP or an Internal/External fault has occurred.

- **CR2 - Arc Active** – This output is asserted after the arc is established. The signal is generated from the Thermal Arc power source. The output is cleared if a loss of arc is detected, internal Program fault, or the cycle start signal is reset.

- **CR3 - Cycle Complete** – This output is asserted when the programmed weld cycle has been completed. If a fault or loss of arc has occurred during the cycle the Cycle complete will not be set.

- **CR4 - Cycle Active** – This output is active during the complete weld cycle and will be cleared at the end of all programmed events.

The interface also provides a ESTOP circuit and six 24 vdc inputs that provide the following control functions:

- **ESTOP** – This input must be active. If the ESTOP is cleared the control performs an emergency stop and halts the weld cycle and resets all outputs. When asserted the controller performs a power up sequence.

- **INP 1 – SCHED 0** – User definable spare input. Under remote schedule mode this input can be used for weld schedule selection (Bit 0).

- **INP 2 – SCHED 1** - User definable spare input. Under remote schedule mode this input can be used for weld schedule selection (Bit 1).

- **INP 3 – SCHED 2/ PARAMETER SELECT** - User definable spare input. Under Remote Schedule Mode this input can be used for weld schedule selection (Bit 2). Under Remote Control Mode this input is used to select the parameter to Increase/Decrease. When Cleared the Current is selected. When Asserted the Wire Feed speed parameter is selected. This option is only active when the optional wire drive and when the Remote control mode is enabled.

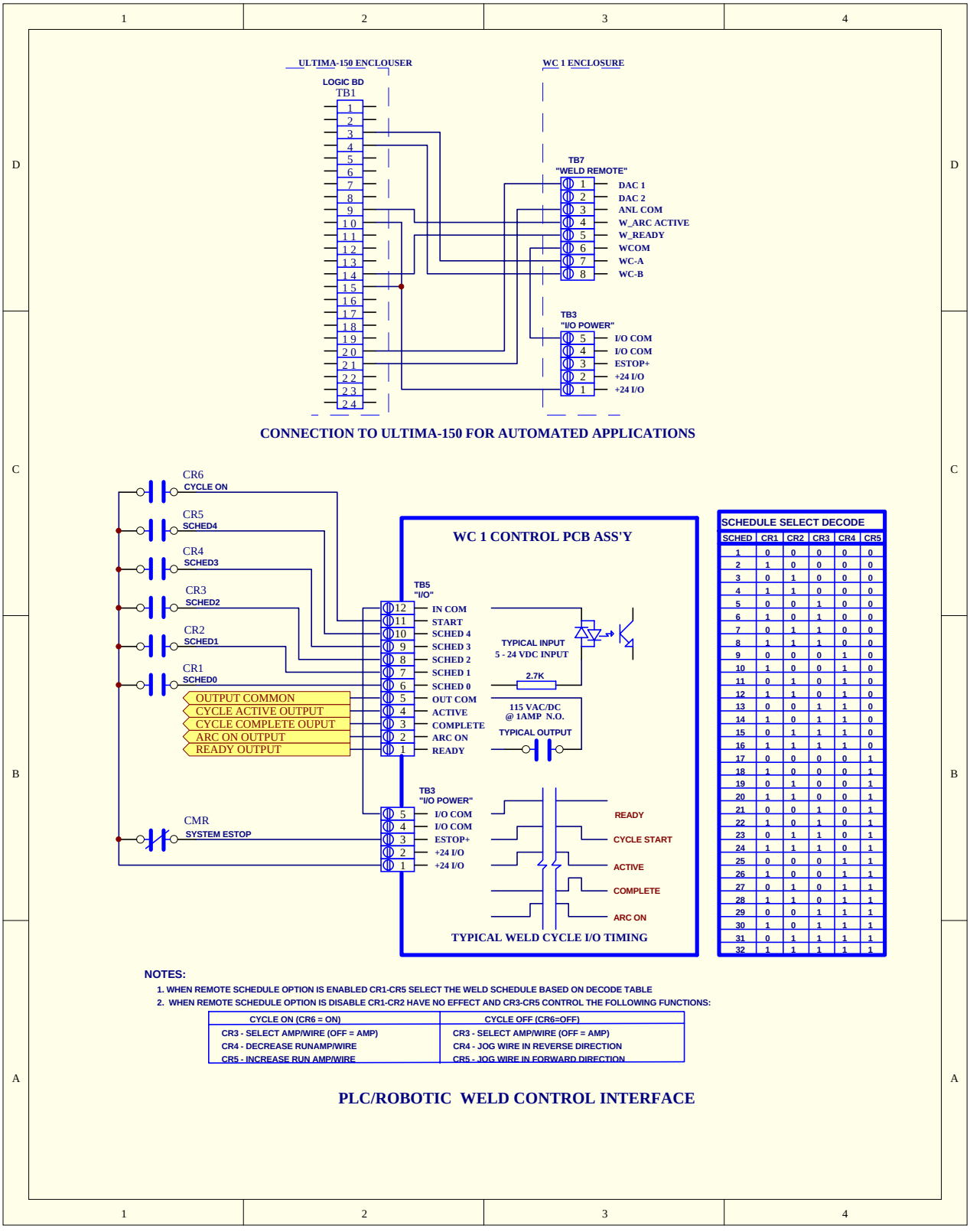
- **INP 4 – SCHED 3/ INCREASE PARAMETER** – User definable spare input. Under Remote Schedule Mode this input can be used for weld schedule selection (Bit 3). Under Remote Control Mode activating this input will increment the selected parameter as specified by INP3.

- **INP 5 – SCHED 4/ DECREASE PARAMETER** - User definable spare input. Under Remote Schedule Mode this input can be used for weld schedule selection (Bit 4). Under Remote Control Mode asserting this input will decrease the selected parameter as specified by INP3.

- **INP 6 - CYCLE START** – This Input, when asserted, will start a weld cycle and must be active during the complete weld cycle. If the input is reset the cycle will be terminated. If the Spot Weld mode is enabled, the weld cycle will be terminated by the user defined weld time. The Cycle start input must be reset before the next weld cycle can be initiated.

To use the Remote control interface the user must connect the PLC or Robot I/O to the internal terminal blocks provide on the Main controller PCB assembly. The Remote Control function must be enabled via the RS-232 serial port terminal command. See Section 7 for additional information.

4.6 Typical User Interface for Automated Operation



5.0 CONTROL SPECIFICATION

5.1 Enclosure Specification

The Weld Sequence Controller consists of a Main CPU P.C. board, Display/Keypad P.C. Board and a 2-line 16-character LCD display. All external user connections are made via seven P.C. Board mounted screw terminal blocks. The controller is designed to allow the addition of a Capstan PWM motor drive controller, which can be used to control the Capstan Cold Wire Feed system. The PWM module is installed in the rear of the control enclosure. There will also be provisions made to install the necessary Power supply components inside the enclosure. This consists of a transformer, and power supply assembly and wiring harness. This allows easy installation of the wire drive controller option. The sheet metal enclosure is a clamshell design and conforms to a NEMA 1 rating.

5.2 Control Cables and Connectors

The enclosure has a single 15 ft rigid mounted power source control cable to interface to the Thermal Arc power source. A rigid mounted 6 ft 115 VAC molded cable is used to provide power to the controller. Provisions are made to allow a rigid mounted Capstan™ drive motor cable and PWM Motor drive control Heat sink assembly to be installed. This option allows the WC 1 to program and control a Capstan™ cold wire feed drive. A 9-pin CPC Circular connector is provided to allow interconnection of an optional operator control pendant. A RS-232-C Female DB-9 connector is provided to allow off-line programming of the weld schedules.

5.3 Controls and Status Indicators

The following is a summary of the front panel controls and status indicators:

- **POWER SWITCH** – Illuminated rocker switch applies power to the controller.
- **PROGRAM/RUN –** Key Lock switch that enables the WC 1 program mode. When the switch is in the program position the user has full access to the controller weld schedules and configuration parameters. When set in the run position the operator can only change the parameters enabled within a specified high/low limit.
- **SELECT –** This momentary pushbutton switch is used to select the WC 1 parameter to be modified. Editing of the selected parameter is only allowed when the key switch is in the program position.
- **INC /DEC –** These two momentary push button are used to increase or decrease the selected parameter. Editing of the selected parameter is only allowed when the key switch is in the program position.
- **START LED** – Indicates when the weld event is in the start sequence.
- **RAMP UP LED** – Indicates when the weld event is in the Ramp Up sequence.
- **RUN LED** – Indicates when the weld event is in the Run sequence.
- **TAPER LED** – Indicates when the weld event is in the Taper sequence.
- **RAMP DOWN LED** – Indicates when the weld event is in the Ramp down sequence.
- **END LED** – Indicates when the weld event is in the End sequence.

- **PROGRAM LED** - Indicates when the WC 1 weld schedule program is active.
- **PULSE LED** - Indicates when the pulse mode is active.

5.4 System Specifications

The following are the system specifications:

Plasma Weld Sequence Controller:

Dimensions:	5.0"H x 9.0"W x 11"L (102mm x 165mm x 280mm)
Power Input:	110 - 240 vac 50/60 hz @ 0.2kw
Operating Temp:	-10 ° F to +140° F (-23°C to +60°C)
Relay Outputs:	115 VAC/VDC 1 amps normally open contact
Switch Inputs:	5 - 24 vdc @ 1.0 - 8.0 ma.
Analog Outputs:	10 vdc precision reference output. 10 bit resolution (10 mv resolution) Maximum output current 10 ma. Output is short circuit protected.
Encoder Input:	Pulse accumulator input 5.0 vdc TTL level with 4.7K pull-up. Maximum input frequency 15 khz.

6.0 OPERATIONAL DISPLAY AND PROGRAMMING

6.1 Static Weld Display Screens

The WC 1 controller provides a 2-line 16-character display and four control switches that allow the user to program the weld variables and to select the various weld schedules. When not altering parameters the display will indicate current status of the controller. The first line of the display will show the product type message. The Second line will show the current set point value for the analog outputs that are enabled. The values displayed are the final values for each weld cycle event. The values are not varied during the ramp or pulse event but are set to the end or peak values. The actual values displayed are the result of the control mode and options installed. The following are the various Weld active Display screens that will be displayed, during a weld cycle, on the second line of the display.

DISPLAY	MESSAGE DESCRIPTION
AMP=###	This screen will be displayed for PAW and GTAW mode when the wire drive option is not installed. (Where: ### is the current set point value)
AMP=### WFS=###	This screen will be displayed for PAW and GTAW mode when the wire drive option is installed. (Where: ### is The current set point value)
VOL=##.# WFS=###	This screen will be displayed for GMAW mode. (Where: ### is The current set point value)

Table 1 - Static Screen Display Message

6.2 Static Display Screen Error Messages

During the weld cycle the WC 1 controller performs diagnostic checks on the system and control inputs. If an error occurs the WC 1 will display the error message on the second line of the static message screen. The following is a summary of the error messages:

DISPLAY	ERROR MESSAGE DESCRIPTION
SCHED 1 READY!	No Errors. Normal static message screen displays active schedule number.
PGM EVENT ERROR!	Program Event Error indicates the active weld schedule has an invalid event enabled. Error is automatically reset when Cycle start is cleared.
POWER NOT READY!	Power supply not ready error indicates the Power supply ready input is not asserted. This error will occur when the Cycle start is asserted and the Ready input is not active. Error is reset when Cycle start is cleared.
ARC ACTIVE FAIL!	The Start parameters are being ramped to the run level and the Ramp time delay is active.
SCHEDULE FAULT!	Schedule Fault Error indicates the active weld schedule has an invalid parameter. This error will occur when an out-of-range parameter is detected during a weld cycle. Error is automatically reset when Cycle start is cleared.
SYSTEM ESTOP	ESTOP message indicates that the WC 1 controller has been forced into a Emergency stop condition by clearing the WC1 ESTOP input. When the ESTOP mode is active all WC 1 outputs and weld events are cleared. The only recovery is to assert the ESTOP input signal.

Table 2 - Displayed Error Messages

6.3 Modifying Weld Schedule and System Parameters

The WC 1 Control provides two methods for programming a weld schedule. The first method is to use a PC and the RS-232 serial port to program the schedules off line. Refer to Section 7.0 for additional information on serial off-line programming. To create, modify or load a schedule set the front panel key-lock switch to the *"PROGRAM"* position. The WC 1 will display the "*WELD PARAMETER*" menu option. Select this menu by pressing the "SEL" button. To change the Control configuration parameters press the "INC" or "DEC" button. The WC 1 will display the "*CONFIG PARAMETER*" menu option. To select a specific menu option, press the "SEL" button. After selecting a menu option the WC 1 will display the menu items and their current values on the display. To move forward through the menu items press the "*INC*" button. To move back to the previous menu item, press the "*DEC*" button. When moving through the menu items the WC 1 will display the current value for each of the items selected. To change any selected item press the "*SELECT*" button. A Blinking cursor will be displayed. To increase the displayed value, press the "*INC*" button. To decrease the value, press the "*DEC*" button. To exit the edit routine press the "*SELECT*" button. The Blinking cursor will be cleared from the display. Move to the next item by pressing the "*INC*" or "*DEC*" buttons. To exit the schedule, edit routine turn the key-lock switch to the "RUN" position. If a value has been modified, by pressing the "*SELECT*" button, the display will show a "SAVING SCHEDULE" prompt indicating that the changes have been saved to the WC 1 nonvolatile Memory. The Display will then return to the normal Static display messages.

6.4 Weld Schedule Parameter Menus

The WC 1 controller can support several different options. Depending on which options are installed three different menus will be displayed. Each menu is specific to the available functions and features that are installed. Placing the key-lock switch to the "**RUN**" position enables the edit function. One of the following Program menus will be displayed.

6.5 PAW Weld Schedule Menu Screens

DISPLAY	PARAMETER DESCRIPTION	RANGE	UNITS
START CURRENT AMP =	Weld cycle start current level.	1 - 500	Amps
START DELAY TIME =	The time period at the Start current level.	0 – 60.00	Sec.
RAMP UP TIME TIME =	The time that will be used to ramp the welding current from the start to the run value.	0 – 60.00	Sec.
RUN TIME CURRENT AMP =	The current level that will be used during the run time portion of the weld cycle.	1- 500	Amps
SPOT WELD TIME TIME =	The time period at the run current. If set the weld sequence will automatically terminate at the end of this time. If zero the user must clear the Cycle start signal to terminate the weld cycle.	0 – 650.00	Sec.
PERCENT TAPER TAPER % =	The percent of run current that will be reached at the end of the taper event.	1 – 100	%
TAPER DELAY TIME TIME =	The time period to perform the current taper event.	0 – 600.00	Sec.
RAMP DOWN TIME TIME =	The time period used to ramp the current from the Taper % level to the end current level.	0 – 60.00	Sec.
END CURRENT AMPS =	The current level that will be used during the end time period.	1 - 500	Amps
END DELAY TIME TIME =	The time period at the end current level.	0 – 60.00	Sec.
PULSE MODE MODE =	Enable/Disable the pulse weld mode. If enabled the pulse mode will be active from the start of the ramp up event to the end of the ramp down event.	0 – 1	Yes/No
PULSE ON TIME TIME =	The time period at the run current level when the pulse mode is active.	.001-60.000	Sec.
PULSE OFF TIME TIME =	The time period at the background current level when the pulse mode is active.	0.001-60.000	Sec.
% BACKGROUND AMP AMP % =	The percent of the peak current value that is used for the background current level.	1-100	%
SELECT SCHEDULE SCHED =	Select the user defined weld schedule and read the schedule from weld memory into the active weld schedule parameters.	1 – 32	
SAVE SCHEDULE SCHED =	Write the current active weld schedule to the specified schedule number in the weld memory.	1 - 32	

Table 3 - Weld Schedule Menu for PAW Welding Mode

6.6 PAW With Cold Wire Feed Option Weld Schedule Menu Screens

DISPLAY	PARAMETER DESCRIPTION	RANGE	UNITS
START CURRENT AMP =	Weld cycle start current level.	1 - 500	Amps
START WIRE SPEED SPEED =	The wire feed speed to be used during the start time period. To disable set the speed to 0.	0-1000	Ipm
START DELAY TIME =	The time period at the Start current level.	0 – 60.00	Sec.
RAMP UP TIME TIME =	The time that will be used to ramp the welding current from the start to the run value.	0 – 60.00	Sec.
RUN TIME CURRENT AMP =	The current level that will be used during the run time portion of the weld cycle.	1- 500	Amps
RUN WIRE SPEED SPEED =	The wire feed speed to be used during the Run time period. To disable set the speed to 0.	0-1000	Ipm
SPOT WELD TIME TIME =	The time period at the run current. If set the weld sequence will automatically terminate at the end of this time. If zero the user must clear the Cycle start signal to terminate the weld cycle.	0 – 650.00	Sec.
PERCENT TAPER TAPER % =	The percent of run current that will be reached at the end of the taper event.	1 – 100	%
TAPER DELAY TIME TIME =	The time period to perform the current taper event.	0 – 600.00	Sec.
RAMP DOWN TIME TIME =	The time period used to ramp the current from the Taper % level to the end current level.	0 – 60.00	Sec.
END CURRENT AMPS =	The current level that will be used during the end time period.	1 - 500	Amps
END WIRE SPEED SPEED =	The wire feed speed to be used during the end time period. To disable set the speed to 0.	0-1000	Ipm
END DELAY TIME TIME =	The time period at the end current level.	0 – 60.00	Sec.
REV WIRE DELAY TIME =	The time period to reverse the wire feeder and back the wire out of the arc. The Wire speed is the end wire value.	0 - 60.00	Sec.
PULSE MODE MODE =	Enable/Disable the pulse weld mode. If enabled the pulse mode will be active from the start of the ramp up event to the end of the ramp down event.	0 – 1	Yes/No
PULSE ON TIME TIME =	The time period at the run current level when the pulse mode is active.	.001-60.000	Sec.
PULSE OFF TIME TIME =	The time period at the background current level when the pulse mode is active.	0.001-60.000	Sec.
JOG WIRE SPEED SPEED =	The wire drive speed that is used while not welding.	0 – 1000	Ipm
% BACKGROUND AMP AMP % =	The percent of the peak current value that is used for the background current level.	1-100	%
SELECT SCHEDULE SCHED =	Select the user defined weld schedule and read the schedule from weld memory into the active weld schedule parameters.	1 – 32	
SAVE SCHEDULE SCHED =	Write the current active weld schedule to the specified schedule number in the weld memory.	1 - 32	

Table 4 - Weld Schedule Menu for PAW with Cold Wire Feed option enabled

6.7 GMAW Option Weld Schedule Menu Screens

DISPLAY	PARAMETER DESCRIPTION	RANGE	UNITS
PREPURGE TIME TIME =	Pre purge gas flow time period.	0 - 60.00	Sec.
START VOLTAGE VOLTS =	Weld cycle start voltage level.	10.0- 50.0	Volts
START WIRE SPEED SPEED =	The wire feed speed to be used during the start time period.	0-1000	Ipm
START DELAY TIME =	The time period at the Start level.	0 – 60.00	Sec.
RAMP UP TIME TIME =	The time that will be used to ramp the parameters from the start to the run value.	0 – 60.00	Sec.
RUN TIME VOLTAGE AMP =	The voltage level that will be used during the run time portion of the weld cycle.	10.0- 50.0	Volts
RUN WIRE SPEED SPEED =	The wire feed speed to be used during the Run time period.	0-1000	Ipm
SPOT WELD TIME TIME =	The time period at the run level. If set the weld sequence will automatically terminate at the end of this time. If zero the user must clear the Cycle start signal to terminate the weld cycle.	0 – 650.00	Sec.
PERCENT TAPER TAPER % =	The percent of run wire speed that will be reached at the end of the taper event.	1 – 100	%
TAPER DELAY TIME TIME =	The time period to perform the taper event.	0 – 600.00	Sec.
RAMP DOWN TIME TIME =	The time period used to ramp from the Taper % level to the end level.	0 – 60.00	Sec.
END VOLTAGE VOLTS =	The voltage level that will be used during the end time period.	10.0– 50.0	Volts
END WIRE SPEED SPEED =	The wire feed speed to be used during the end time period.	0-1000	Ipm
END DELAY TIME TIME =	The time period at the end level.	0 – 60.00	Sec.
REV WIRE DELAY TIME =	The time period to reverse the wire feeder and back the wire out of the arc. The Wire speed is the end wire value.	0 - 60.00	Sec.
BURN BACK TIME TIME =	The time period, which will be used to hold the weld contactor on after halting the wire feed motor.	.01 - 6.00	Sec.
POST PURGE TIME TIME =	The Post Gas flow time period.	.01-60.00	Sec.
JOG WIRE SPEED SPEED =	The wire drive speed that is used while not welding.	0 – 1000	Ipm
SELECT SCHEDULE SCHED =	Select the user defined weld schedule and read the schedule from weld memory into the active weld schedule parameters.	1 – 32	
SAVE SCHEDULE SCHED =	Write the current active weld schedule to the specified schedule number in the weld memory.	1 - 32	

Table 5 - Weld Schedule Menu for GMAW option enabled

6.8 Setup Parameter Menus

The WC 1 controller can support several different options. The setup Parameter menu allows the user to configure various setup control parameters and options. Depending on which options are enabled different Weld parameter menus will be displayed. The user can also specify the current range for a power supply and enable remote I/O weld schedule selections.

6.9 Setup Parameter Menu Screens

DISPLAY	PARAMETER DESCRIPTION	RANGE	UNITS
REMOTE SCHEDULE SELECT =	Enable remote weld schedule option. When "ON" the user supplied I/O SCHED 0 - 4 inputs (TB5-6- TB5-10) will specify the desired weld schedule. Refer to Section 4.5 for additional information	ON/OFF	
GTAW CONTROL MODE =	Enables the GTAW process mode and weld parameter menus	ON/OFF	
GMAW CONTROL MODE =	Enables the WC 1 control for the GMAW (MIG/MAG) process mode and weld parameter menu	ON/OFF	
MAX CURRENT AMP =	The Maximum current level that the power source can provide. This value is used to scale the WC 1 analog output.	1- 500	Amps
MIN CURRENT AMP =	The Minimum current level that the power source can provide. This value is used to scale the WC 1 analog output.	1- 500	Amps

Table 6- Setup Parameter menu functions

7.0 WC 1 OFF-LINE RS-232 TERMINAL PROTOCOL

7.1 General Description

The RS-232 Terminal mode can be used to off-line program the user configurable parameters and operating modes. The protocol is a simple ASCII command string that allows the user to upload or download the various data. The user can use any terminal program to perform the programming function. All program command functions are case sensitive. The serial port is configured for the following data format:

- Baud Rate: 19.2K, Full Duplex
- Word Length: 8 Data Bits, One Stop and no parity
- Hand Shaking: None

7.2 Terminal Protocol

The protocol consists of a command string and optional data bytes. The command string is an alpha character and an option number followed by a "=" or "?", followed by optional data and terminated with an ASCII "cr" (0dh). The "=" will indicate that data is being sent to the selected parameter by the host controller. The "?" will indicate a request for data from the WC 1 to the host controller. If the host is sending data to the WC 1 the data will be placed after the "=" character and will be an ASCII string terminated with an ASCII "cr" (0dh). The following is an example of reading a parameter value from the WC 1:

From Host type: **V1? (cr)**
Response from WC 1: **##**

Where: ## is the current value for the parameter and (cr) is the enter key

The following is an example of how to modify a value in the WC 1 using the terminal commands:

From Host type: **V1=#### (cr)**

Where: ## is the new value for the parameter and (cr) is the enter key

7.3 Terminal Commands

The following is a summary of the Terminal Commands supported by the WC 1:

COMMAND	PARAMETER DESCRIPTION	RANGE	UNITS
V1	Prepurge time	0-650.00	.01Sec.
V2	Arc start current	0-500	Amps
V3	Arc Start Wire feed speed	0-650	Ipm
V4	Arc Start delay time	0-650.00	.01 Sec.
V5	Ramp up Delay time	0-650.00	.01 Sec
V6	Run time current (Pulse Peak current)	0-650.00	Amps
V7	Run Time wire feed speed	0-650	Ipm
V8	Spot Weld Time (If Time=0 then Manual control)	0-650.00	.01 Sec.
V9	Percent Taper current	0-100	%
V10	Taper current delay time	0-650.00	.01 Sec.
V11	Ramp down delay time	0-650.00	.01 Sec.
V12	End current value	0-500	Amps
V13	End wire feed speed	0-650	Ipm
V14	End delay time	0-650.00	.01 Sec.
V15	Reverse wire speed time delay	0-650.00	Sec.
V16	Wire burn back delay time	0-650.00	.01 Sec.
V17	Post gas flow time delay	0-650.00	.01 Sec.
V18	Pulse current on time	.001 – 65.000	.001 Sec.
V19	Pulse current off time	.001 – 65.000	.001 Sec.
V20	Percent back ground current	0-100	%
V21	Jog wire feed speed	0-650	Ipm

Table 7 - Weld Process and Command Table

COMMAND	PARAMETER DESCRIPTION	RANGE
M1	Read Remote Inputs BIT 0 – Schedule Bit 0 input TB5-6 BIT 1 – Schedule Bit 1 input TB5-7 BIT 2 – Schedule Bit 2 input TB5-8 BIT 3 – Schedule Bit 3 input TB5-9 BIT 4 – Schedule Bit 4 input TB5-10 BIT 5 – Power Supply Ready Input TB7-5 BIT 6 – Arc Active Input TB7-4 BIT 7 – Cycle Start Input TB5-11	0-255
M2	Read/Write Remote Relay Outputs CR1-CR6 BIT 0 – CR1 Weld Contactor Output TB7-7 & TB7-8 BIT 1 – CR2 Control Ready Output TB5-1 BIT 2 – CR3 Arc Active Output TB5-2 BIT 3 – CR4 Weld Cycle Complete Output TB5-3 BIT 4 – CR5 Weld Cycle Active Output TB5-4 BIT 5 – CR6 Enable Wire Drive Output TB4-4	0-255
M3	Read/Write System Configuration Parameters BIT 0 – Enable Remote Schedule Select Function BIT 1 – Enable Wire Feed control functions BIT 2 – Enable GMAW weld mode functions BIT 3 – Enable GTAW weld mode functions	0-15
M4	Terminal Baud Rate control 0 = 76.8K Baud 1 = 38.4K Baud 2 = 19.2K Baud (Default) 3 = 9600 Baud 4 = 4800 Baud 5 = 2400 Baud 6 = 1200 Baud	0-6
M5	Weld Control Error Code 0 - No Error 1 - Weld Sequence Program Fault 2 - Power Supply Not Ready Fault 3 - ARC fail during weld cycle 4 - Schedule Fault – Invalid Parameter Data 5 - ESTOP active	1-5
M6	Set to “M6=251” and power cycle the WC1 will Clear Memory and reload factory default parameters (Version 1.23 and higher).	251

Table 8 - System Configuration and Mode command table

COMMAND	PARAMETER DESCRIPTION	RANGE
W1	Weld Schedule Mode Flag: Bit 0 – Enable Pulse Weld Mode Bit 1..7 – Not defined	0-255
W2	Active Weld Schedule number	1-32
W3	Active Weld Event number 0 - Cycle Off 1 - Cycle Start 2 - Pre Purge 3 - Start Time 4 - Ramp Up Time 5 - Run Time (Spot Weld Time if enabled) 6 - Taper Current time 7 - Ramp Down Time 8 - End Time 9 - Wire Reverse Time 10 - Burn Back Time 11 - Post Purge Time	0-11
W4	Write current schedule to specified weld schedule number	1-32
W5	Read specified weld schedule from memory to active schedule	1-32

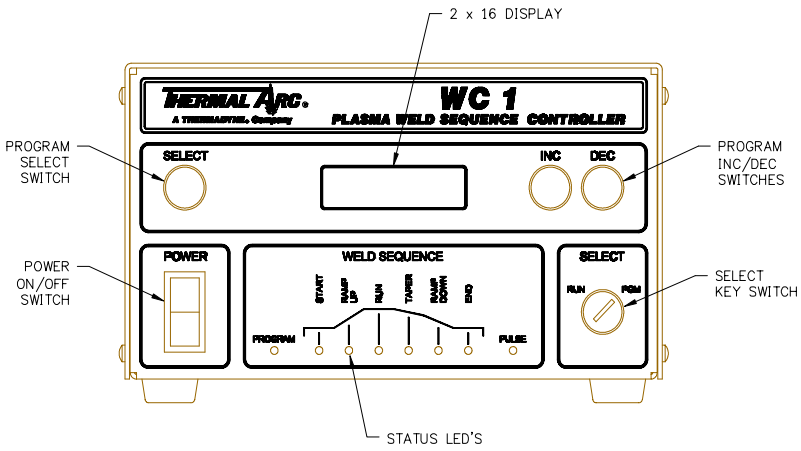
Table 9 - Weld Mode Command Table

COMMAND	PARAMETER DESCRIPTION	RANGE
A1	Minimum Power supply current output (A1 = AMP_{min}) used for DAC 1 scaling.	0-255
A2	Maximum Power supply current (A2=AMP_{max}) used for DAC 1 scaling Where: (DAC 1 Gain = [4000/(AMP_{max} – AMP_{min})])	0-500
A3	Minimum Wire Feed speed (A3 = $WIRE_{min}$) used for DAC 2 scaling	0-255
A4	Maximum Wire Feed Speed (A5=$WIRE_{max}$) used for DAC 2 scaling Where: (DAC 2 Gain = [4000/($Wire_{max}$ – $WIRE_{min}$)])	0-900
A5	Actual Setpoint value for DAC 1	0-500
A6	Actual Set point value for DAC2	0-900

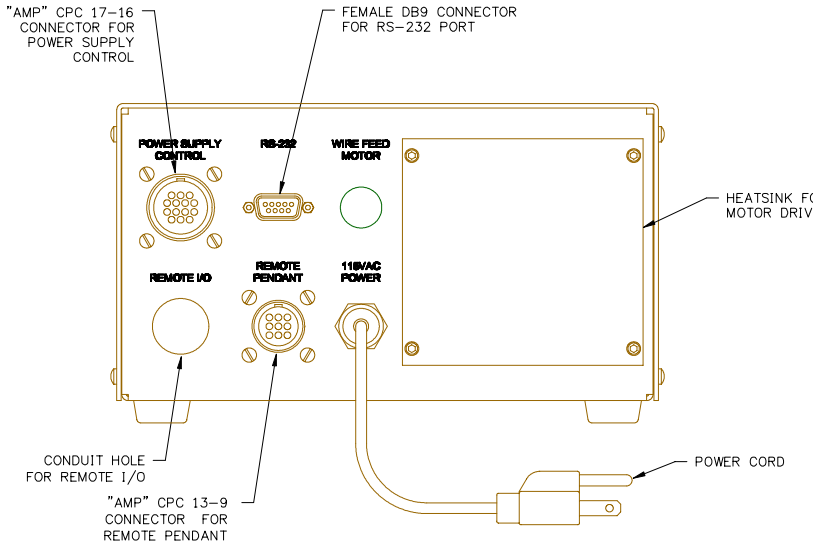
Table 10 - Analog Scaling Command Table

8.0 ENCLOSURE LAYOUTS

8.1 WC 1 Control Enclosure - Standard Layout P/N: C3A5003

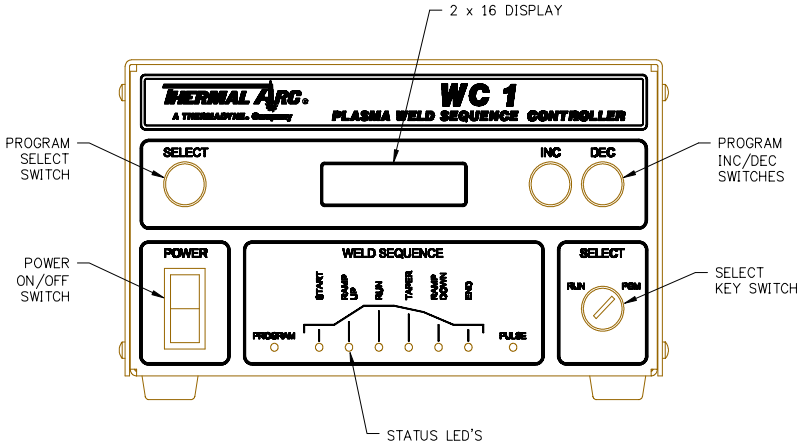


FRONT VIEW



REAR VIEW

8.2 WC 1 Control Enclosure - Capstan Motor Drive Layout P/N: C3A5004



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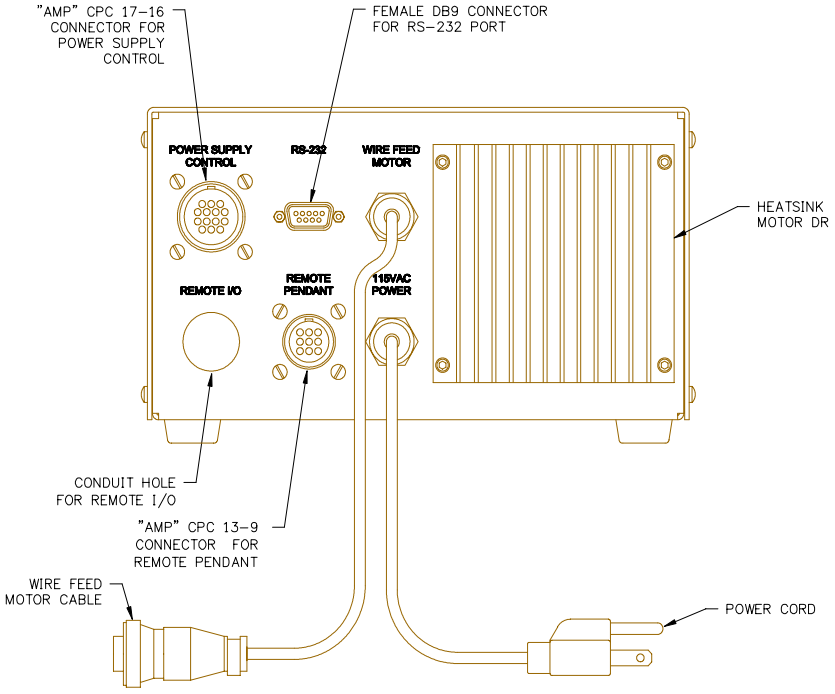
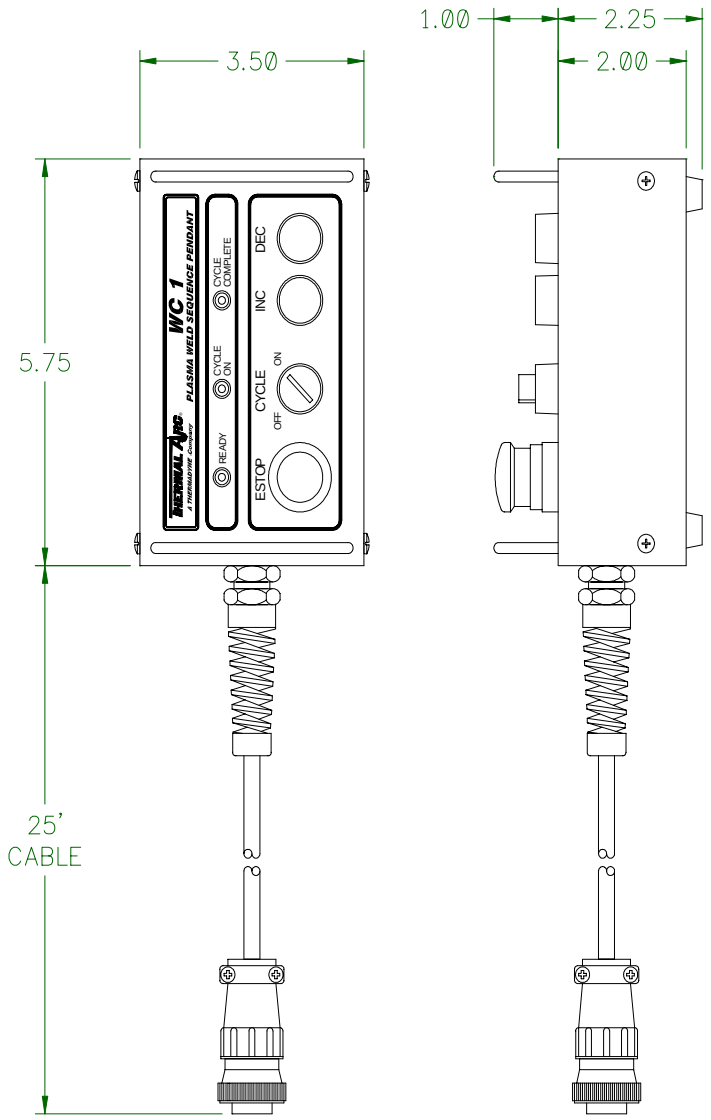


REAR VIEW

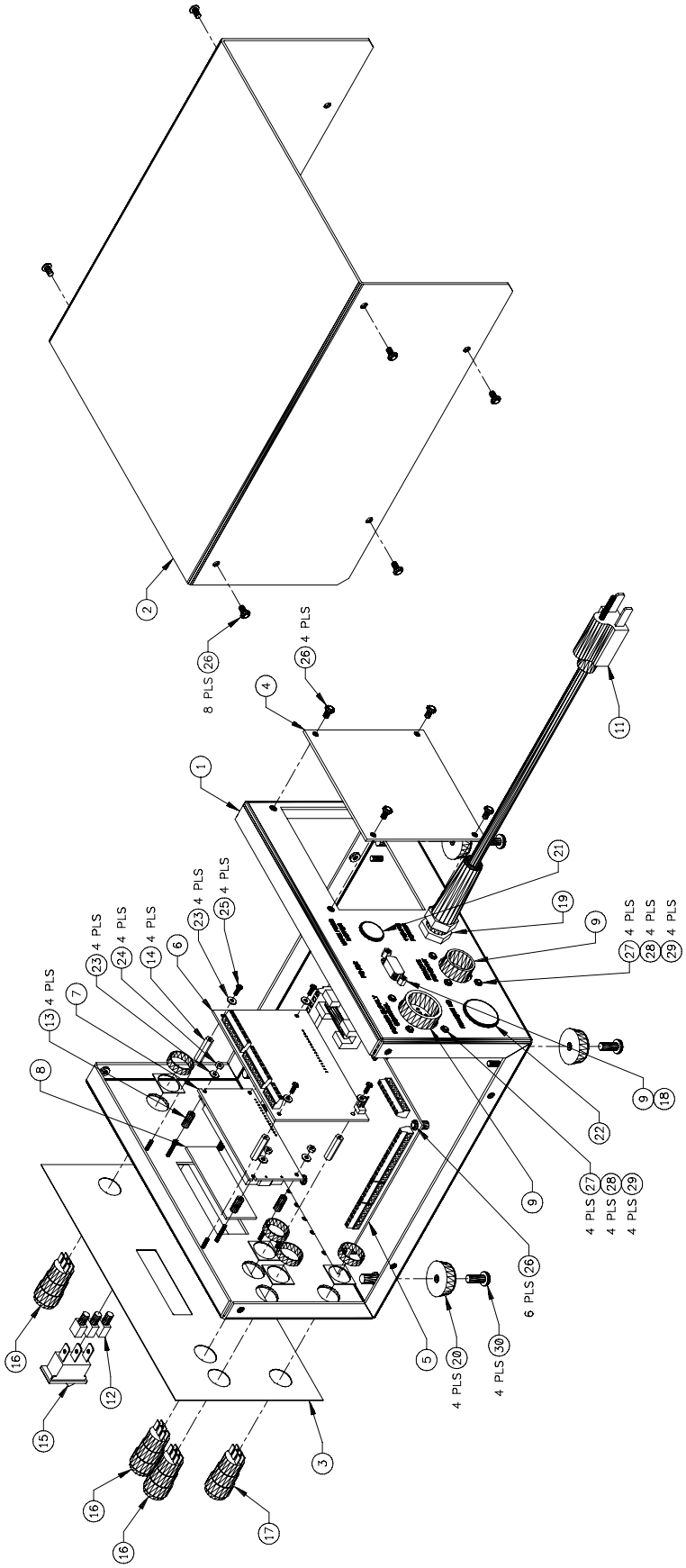
8.3 Operator Pendant P/N: C3A5006



9.0 ENCLOSURE PARTS LISTS

9.1 WC 1 Control Enclosure - Standard Layout P/N: C3A5003

ITEM	QTY	PART NO	DESCRIPTION
1	1	C3A5003	WC 1 Control Enclosure
2	1	C3E5004	WC 1 Control Cover
3	1	C3E5005	WC 1 Control Front Overlay
4	1	C3E5010	WC 1 Control Cover Plate
5	1	C5A5003-WC	Weld Control PCB Assembly
6	1	C5A5004-WC	Universal Pendant PCB Assembly
7	1	S3A5031	2 x 16 LCD Display Assembly
8	1	S2M5087	2 x 16 LCD Display Lens
9	1	C3W5002	WC 1 Control Wire Harness
10	1	C3W5003	WC 1 Front Panel Wire Harness
11	1	C3W5004	WC 1 Power Cord
12	1	C3W5005	WC 1 Power Switch Wire Harness
13	4	X6S5050	Spacer, #2 x 7/16” Long Nylon HH Smith #9165
14	4	X6S5056	Spacer, #2-56 x ¾” Long Stainless Steel RAF #2061-256-SS
15	1	X3S5078	Switch, Power Rocker Cutler-Hammer #1600R11E
16	3	X3S5125	Switch, Black Pushbutton SPDT Idec #AB6M-M1-B
17	1	X3S5127	Switch, Keylock SPDT Idec #AS6M-2KT2PB
18	1	X3Z5027	Kit, Screwlock Std. Female Amp #205817-3
19	1	X3Z5006	Fitting, Black Pigtail Heyco #3240
20	4	X6Z5036	Bumper, Black HH Smith #2135
21	1	X6Z5089	Plug, Dome Hole Black 5/8" Heyco #2663
22	1	X6Z5069	Plug, Dome Hole Black 7/8" Heyco #2703
23	8		#2 Internal Lock Washer
24	4		#2-56 Hex Nut
25	4		#2-56 X 1/4" Long Pan Head Screw
26	18		#6-32 X 1/4" Long Pan Head Screw w/ Internal Lock Washer
27	8		#6-32 X 1/2" Long Pan Head Screw
28	8		#6 Internal Lock Washer
29	9		#6-32 Hex Nut
30	4		#10-32 X 1/2" Long Pan Head Screw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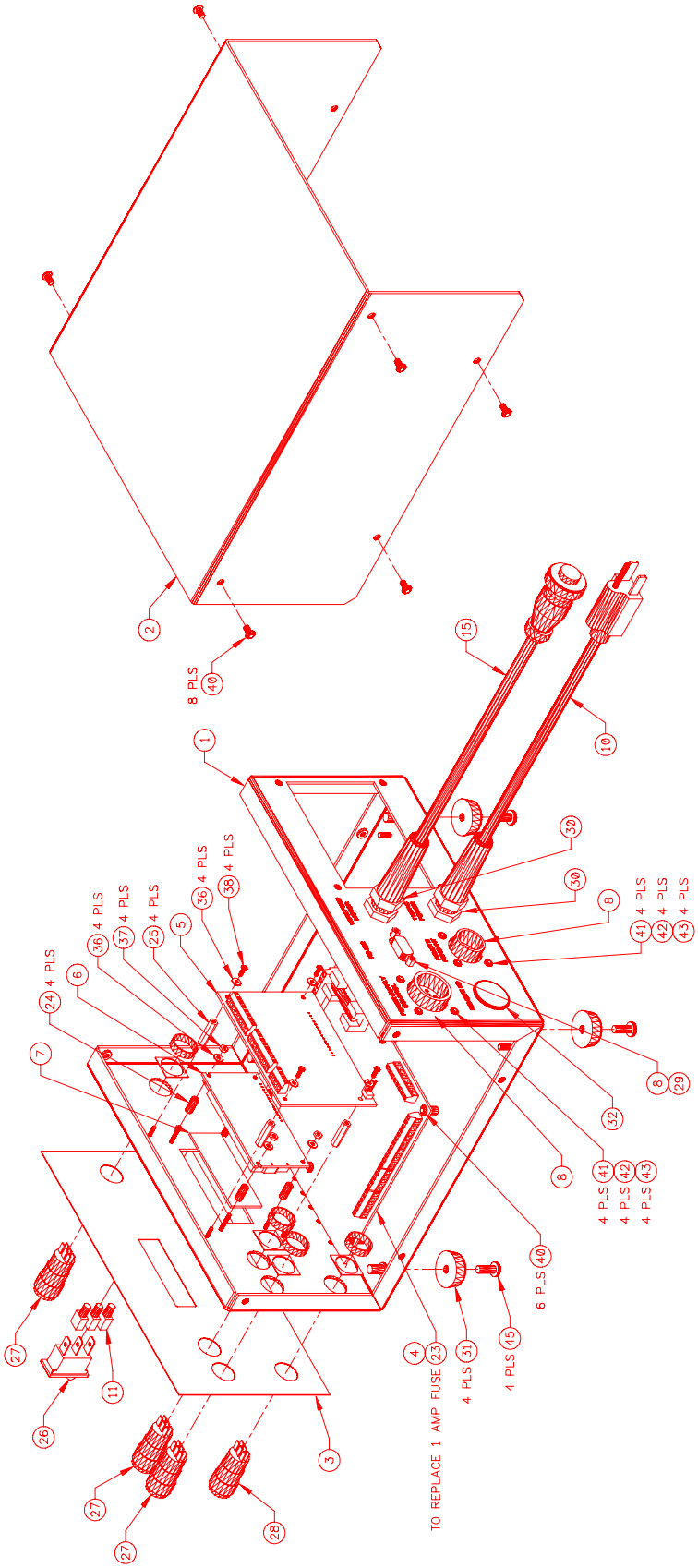
9.2 WC 1 Control Enclosure – Capstan Motor Drive Layout P/N: C3A5004

ITEM	QTY	PART NO	DESCRIPTION
1	1	C3A5003	WC 1 Control Enclosure
2	1	C3E5004	WC 1 Control Cover
3	1	C3E5005	WC 1 Control Front Overlay
4	1	C5A5003-WC	Weld Control PCB Assembly
5	1	C5A5004-WC	Universal Pendant PCB Assembly
6	1	S3A5031	2 x 16 LCD Display Assembly
7	1	S2M5087	2 x 16 LCD Display Lens
8	1	C3W5002	WC 1 Control Wire Harness
9	1	C3W5003	WC 1 Front Panel Wire Harness
10	1	C3W5004	WC 1 Power Cord
11	1	C3W5005	WC 1 Power Switch Wire Harness
12	1	C3W5006	PWM Control Wire Harness
13	1	C3W5007	PWM AC Power Wire Harness
14	1	C3W5008	PWM DC Power Wire Harness
15	1	C3W5009	PWM Motor Drive Cable
16	1	C3W5010	PWM Toroidal Transformer
17	1	S2M5050	Microstep Heatsink
18	1	C5A5005	PWM Driver PCB Assembly
19	1	C5A5006-9CM	PWM 9CM CPU PCB Assembly
20	1	C5A5007	PWM Power Supply PCB Assembly
21	7	X6S5023	Spacer, #6-32 x 1/2” Long SS M-F RAF #4534-632-SS-0
22	4	X6S5057	Spacer, #6-32 x 1/4” Long SS M-F RAF #4530-632-SS-0
23	1	X3C5026	Fuse, 8 amp 3ag Littlefuse #313008
24	4	X6S5050	Spacer, #2 x 7/16” Long Nylon HH Smith #9165
25	4	X6S5056	Spacer, #2-56 x ¾” Long Stainless Steel RAF #2061-256-SS
26	1	X3S5078	Switch, Power Rocker Cutler-Hammer #1600R11E
27	3	X3S5125	Switch, Black Pushbutton SPDT Idec #AB6M-M1-B
28	1	X3S5127	Switch, Keylock SPDT Idec #AS6M-2KT2PB
29	1	X3Z5027	Kit, Screwlock Std. Female Amp #205817-3
30	2	X3Z5006	Fitting, Black Pigtail Heyco #3240
31	4	X6Z5036	Bumper, Black HH Smith #2135
32	1	X6Z5069	Plug, Dome Hole Black 7/8" Heyco #2703
33	4	X5Z5007	Washer, Shoulder Thermalloy #7721-7PPS
34	3”		Tape, Kapton 1” Wide
35	A/R		Compound, Thermal Thermalloy #249
36	8		#2 Internal Lock Washer
37	4		#2-56 Hex Nut
38	4		#2-56 X 1/4" Long Pan Head Screw
39	4		#4-40 x 1/4” Long Pan Head Screw
40	18		#6-32 X 1/4" Long Pan Head Screw w/ Internal Lock Washer
41	8		#6-32 X 1/2" Long Pan Head Screw
42	8		#6 Internal Lock Washer
43	9		#6-32 Hex Nut
44	4		#6-32 X 3/8" Long Socket Cap Head Screw
45	4		#10-32 X 1/2" Long Pan Head Screw
46	1		#10-32 X 7/8" Long Pan Head Screw
47	1		#10 External Lock Washer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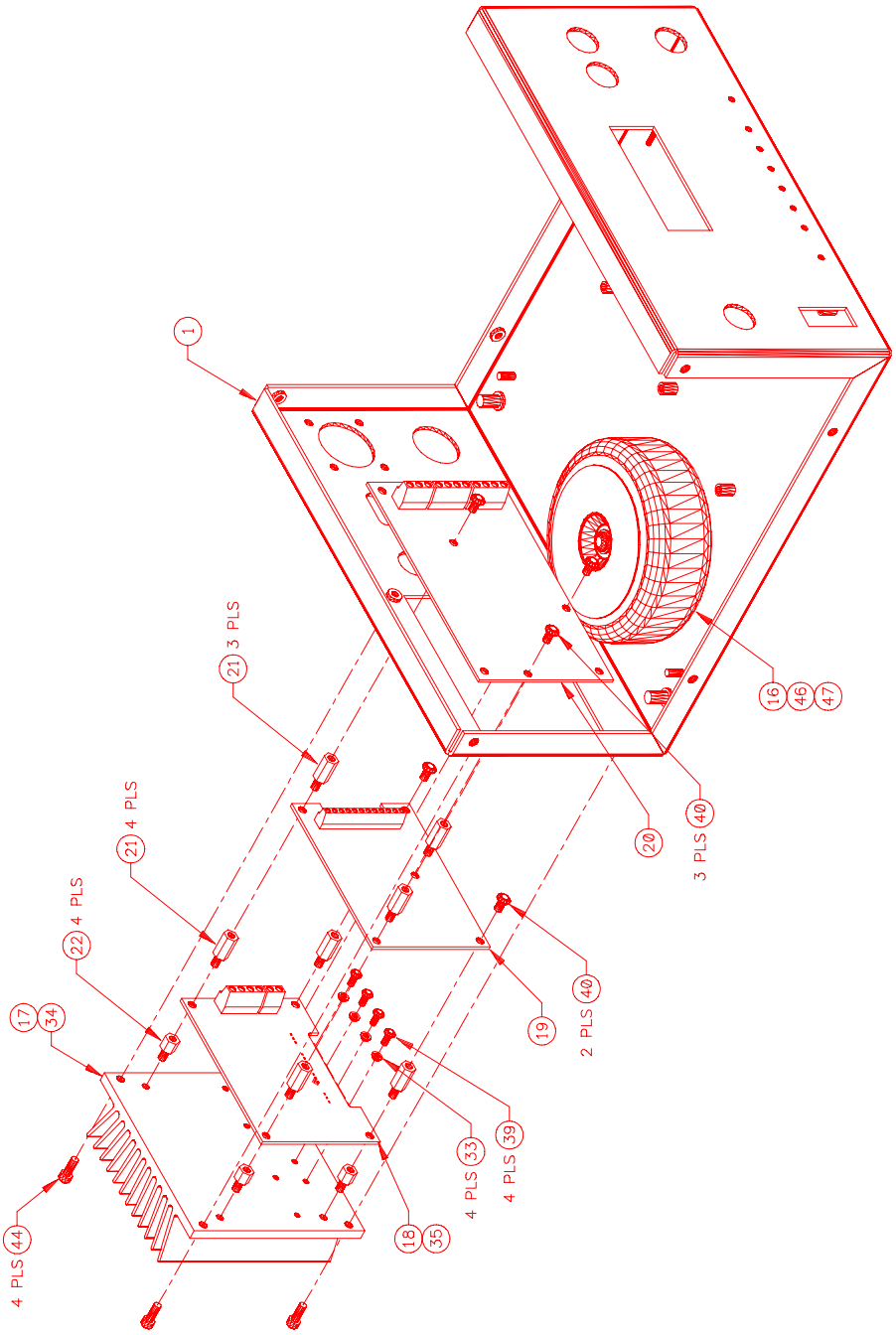
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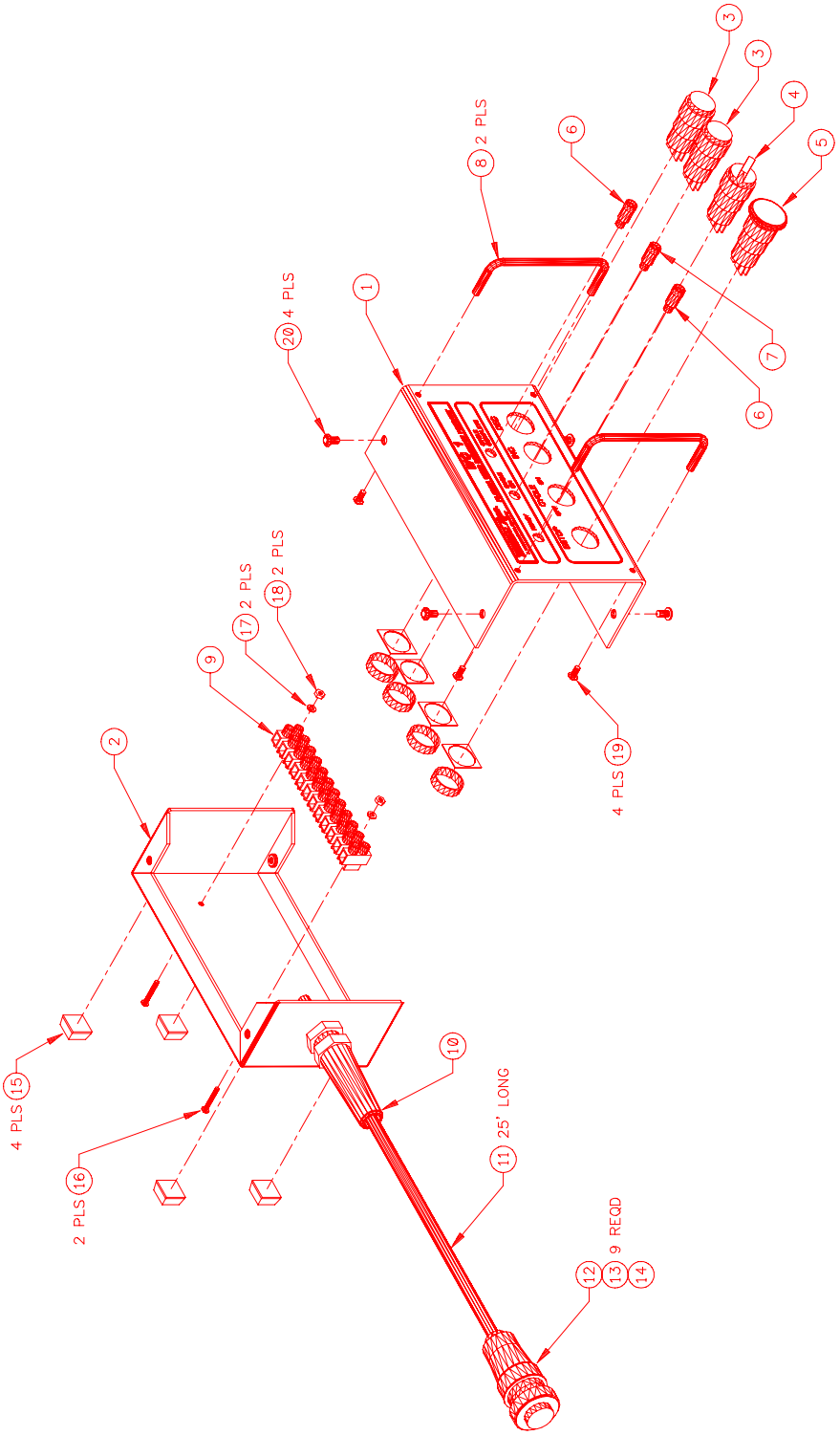
16 46 47

9.3 WC 1 Pendant Enclosure P/N: C3A5006

ITEM	QTY	PART NO	DESCRIPTION
1	1	C3A5007	WC 1 Pendant Base
2	1	C3E5008	WC 1 Pendant Cover
3	2	X3S5125	Switch, Black Pushbutton SPDT Idec #AB6M-M1-B
4	1	X3S5126	Switch, Selector SPDT Idec #AS6M-2Y2P
5	1	X3S5128	Switch, Pushbutton Red SPDT Idec #AB6M-V1-R
6	2	X5D5052	LED, Green Imlec #LED-407G
7	1	X5D5053	LED, Red Imlec #LED-407R
8	2	X6A5014	Handle, Black 3” Center RAF #8047-440-A-24
9	1	X3P5793	Strip, Terminal 12 Circuit Molex #C1512-151
10	1	X3Z5006	Fitting, Black Pigtail Heyco #3240
11	25’	X3W5097	Cable, 8 Cond. 26awg Shielded Belden #1213A
12	1	X3P5142	Connector, Plug Housing 9 pin CPC Amp #206708-1
13	9	X3P0303	Socket, Crimp 20-24 Gauge Amp #66105-2
14	1	X3Z5060	Clamp, Cable CPC Amp #206966-1
15	4	X6Z5090	Bumper, Black Self-Adhesive HH Smith #2446-103
16	3	X5R0051	Resistor, 2.7K ohm 5% 1/2W #RL20S272G
17	2		#2-56 X 5/8" Long Pan Head Screw
18	2		#2 Internal Lock Washer
19	2		#2-56 Hex Nut
20	4		#4-40 X 1/4" Long Pan Head Screw w/ Internal Lock Washer
21	4		#6-32 X 1/4" Long Pan Head Screw w/ Internal Lock Washer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